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ABSTRACT

This personal account of the development of computer-based learning from the 1960s to the present argues that the 1960s were a period of gestation. Instructional applications of computers at that time included efforts to simulate physics experiments and the debut of the PLATO system, which already had the ability to deliver interactive instruction via a computer located miles away. Computer-assisted instruction (CAI) spread to academia in the 1970s, with CAI courses and PLATO workshops being held for both university faculty and students early in the decade. Students were enthusiastic about the system, and faculty at Indiana University-Purdue University at Fort Wayne teamed with students trained in the Tutor language of PLATO to develop CAI materials. PLATO materials were used in the implementation of the personalized system of instruction in the classroom, which involved mastery learning, self-paced instruction, lack of lecture, written material for each unit, and peer tutors. No longer considered 'toys,' and accepted for use in university environments, computer-based training was introduced into the work setting in the late 1970s to meet corporate training needs. The early 1980s saw computers finding widespread applications in both the school and the home with drill-and-practice lessons and small computer games. Software was developed for the home market, and PLATO materials for a large time-shared mainframe were adapted for use with a home computer that could be tied into a larger network at times. The focus on commercial markets for CAI continued in the late 1980s, technology was refined, and more and more applications in a variety of settings were developed. Predictions for the 1990s include a resolution of the schism between those who view CAI as helping people to learn how to do something, and expert systems, as helping people to do something directly. (23 references) (DB)

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# LESSONS LEARNED IN COMPUTER-BASED LEARNING

by

Kenneth L. Modesitt

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## THE 1960'S: A TIME OF GESTATION

I entered the University of Illinois in the fall of 1959, fresh from an excellent suburban high school outside Chicago, and with a deep abiding interest in rockets and space. Engineering physics was the means by which I would attain my goal of landing on the moon one day, just as I had predicted that someone would do during my 1957 physics class. Within a year, this interest had led to discovering the Illiac I digital computer, housed in the basement of the Engineering Research Laboratory (ERL). Before the end of my college career, I was working as a research lab assistant on the Illiac I, the IBM 7090, and the IBM 650. Only faintly heard were rumors of some people in physics who were working on the top floor of the same ERL building. There were indications that a particularly inspired faculty member was trying to simulate physics experiments by use of computer, with the intention of using such simulations for his students to aid in their learning. Not until the end of this decade, around 1968-69, did I learn that the "inspired" faculty member was Professor Donald Bitzer. Don came to Colorado State University, where I had earlier helped start the computer science program, after receiving advanced degrees from Stanford and Carnegie Tech. There, he demonstrated the current ability of PLATO to deliver effective interactive instruction via a computer which was physically located at the University of Illinois, a thousand miles away! This piqued my interest considerably, having previously considered computers as excellent scientific and business tools. By the next term, I had put together an experimental course on "computer-assisted instruction" (CAI).

What had been learned about CBL during this period? The most important was simply the fact that a computer could be used for instruction -- an "obvious" analogy of applying computing power and interactivity to the process of learning. Also discovered was that CBL did exist -- it was not just a theory -- and that it seemed to work on a very small scale. Moreover, people were extremely excited about it. Their creativity was astounding!

## THE EARLY 1970'S: CBL SPREADS TO ACADEMIA

Within a few months of receiving my doctorate in computer science from Washington State University in 1972, I had accepted a position as assistant professor at Indiana University - Purdue University at Fort Wayne (IPFW). No sooner had the first semester started than my department head, Professor Maynard Mansfield, who knew of my interest in CAI, asked if I would be interested in attending a PLATO workshop for prospective faculty authors at the University of Illinois. I jumped at the chance, and upon returning, became the first site director for PLATO in Indiana. That the plasma panels for PLATO were made by the Fort Wayne firm of Magnavox also helped!

The relationship with Bill Golden at the Computer-based Education Reserch Lab (CERL) (same ERL building as twelve years earlier) began with his leading our workshop, and the manifold skills he displays to this day. His appreciation and work for CBL in general and PLATO in particular is an invaluable contribution to the success the field has today, in my opinion.

Courses were begun immediately on CAI and PLATO. The "addiction" of students to the system was just as strong at IPFW as system-wide. Suggestions were made about indexing the hundred or so lessons by subject and keyword, as is done today in the on-line catalog. Rather than have the students continue to develop "shift-stop-itis", I wrote a grant for faculty development of CAI materials. The grant teamed faculty from five disciplines with students trained in the Tutor language of PLATO. The work proceeded as recommended by Bill Golden and other experienced authors, using team design, peer review, and what we now call rapid prototyping: the involvement of the end-user in the courseware development cycle. The lessons which resulted were tied into other existing modules by all the faculty involved. Movies were made of the products and the process, and were shown to a large number of local schools. A number of local industries even extended invitations to be informed about how students were using this new mode of learning. The State of Indiana commissioned a group of academics to formulate a strategy for introducing CAI to higher education in the state, and requested my assistance.

At approximately the same time, I began the classroom use of the Personalized System of Instruction (PSI) first promoted by Fred Keller (Modesitt, 1974a, 1974b, 1975). This system consists of several major components with the emphasis being on mastery-based learning, along with self-paced instruction, lack of lecture, written material for each unit, and peer tutors. I found that the growing base of

courseware on PLATO could be used to augment the written material. Soon, I discovered that the strictly individual mode of learning stressed by Keller was inadequate for the type of education I wished to promote. The addition of group projects was facilitated by the networking capability of PLATO and the various notes features. All of these capabilities were used in a different environment, when I taught a graduate course in CAI at the University of Nebraska in the summer of 1975.

The lessons learned during this period were extensive. CAI had grown from being an interesting "toy" or research prototype to becoming a feasibility one. CAI really could work on a reasonable scale in a university environment, other than the one in which it had been created. Faculty could be motivated and convinced that the development of high quality CAI software (courseware) was a possible route to tenure and promotion. Many students could grasp the essentials of programming in an instructional language, and quickly outdistance their faculty teachers in this regard. These same student programmers could also develop a sense of "ownership" and "monopoly" of a scarce resource -- PLATO terminals -- to the detriment of the end-users. Finally, it was realized that CAI could be valuable component of and addition to other modes of instruction.

## THE LATE 1970'S: INDUSTRY "DISCOVERS" CBL

Soon after giving my first talk at an ADCIS conference (Modesitt, 1976), a feeling of restlessness set in, and a decision was made to move to California on a visiting professorship, where the CAI course was again given successfully. The uneasiness finally manifested itself in a major decision, to return to industry after a 10 year absence. I felt that the full potential of CAI was not being fulfilled in the university. The advent of the personal computer in the same period helped me understand that CBL could be a vital application in the home environment as well.

While working as a software engineer and teaching courses for industry, it became apparent to me that courseware development could also profit from some of the methodology being used for large software projects. Moreover, the cost of training new employees and retraining older ones in new methods was substantial in industry. Here, students were paid while they learned new topics, a radical departure from the university! Hence, my definition of computer-based learning was expanded to include not only computer-based education (CBE), but also computer-based training (CBT).

Within a year, I had persuaded my manager to lease a terminal with PLATO access to the Control Data System (CDC had taken on PLATO as a product line in July, 1976, after NSF funding ceased for CERL). We also had access to the CERL system, since much of the research and development continued to be performed there (and still is!). I hired people to develop courseware for the version of Pascal being used by my employer, and selected one to be the co-site director. These people were hired as a result of numerous conversations over PLATO -- truly long-distance hiring.

To increase the leverage of CBL at the corporation, I agreed to be the first corporate education director and promoted computers and training across many of the divisions, both at the national and international levels. Corporate-wide forums were held on CBL as well as ones involving training directors involved with CBL from other major corporations and universities. It was during this time that Bob Fratini of Western Electric, Chuck Buchanan of United Airlines, and I started the =industry= notefile to provide a forum for the rapidly growing number of industries on PLATO.

The lessons learned in this five year time frame were critical ones: industry was a large and motivated location in which learning was gaining importance rapidly (Modesitt, 1981a, 1981b, 1982). High technology firms were seeing the knowledge of their expensive employees become obsolete quickly. Cost-effective solutions to training needs were very much in demand. And CBL (CBT) was a very promising such technology.

## THE EARLY 1980'S: CBL AND THE HOME

With computers and instruction finding widespread application in the context of schools and work, it was clearly only a matter of time until the same combination appeared in the home. A number of small computer games and some drill-and-practice math lessons were already on the Apple and Radio Shack home computers, most of which were initially found in the lower grade levels.

In 1981, as I was walking from a meeting on CBT with one division to another, a simple idea occurred to me -- why not migrate the existing high-quality

and proven PLATO courseware now available on a large time-shared mainframe to a home computer? To be sure, there would be some loss of screen fidelity, but the gain in other areas would more than compensate: dramatically increased availability via low cost of successful and proven educational software. This would be software which had already amply demonstrated the ability of students to improve their learning. It would also be necessary for these same home computers to be tied into the larger network at times.

The next several years were spent in bringing this dream to reality. As program manager for educational software on the home computer of a major corporation, I worked with Control Data Corporation to move over 800 hours of proven PLATO courseware to a home computer environment. Concurrently, collaborative efforts were made with many experienced PLATO authors to develop new courseware for the home market. Contracts were let to specify, design, and implement a PLATO terminal emulator for the small computer. Suggestions were given on the requirements of new authoring systems and languages being developed by Control Data and CERL. Only a little time was available for writing papers detailing all the exciting work underway (Modesitt, 1983).

The products were brought to market in 1983, selling well into the home via retail outlets, as well as the schools. Much to the amazement of myself and the general computer industry, the corporation decided to leave the home computer market within a few months after the first releases. Although the substantial initial investment had already been repaid over 50% within those first few months, the decision was irrevocable.

Lessons learned in this era were very hard ones: commercial markets for CBL were not yet well-established, and the providers of such programs had best be conservative. Hard work and long hours do <u>not</u> guarantee success, even when combined with the brightest people in the business of PLATO software, whether university (CERL) or industry (CDC) or independent. It is marvelous to have creative ideas, yet that is not sufficient. Dreams die hard...

## THE LATE 1980'S: CBL AS THE YOUNG ADULT

The initial concern about the death of the dream for affordable computer-based learning was inaccurate. The "wrong" home computer had simply been selected for this first venture, in one respect. One has only to look around in industry, schools and the home to see that computers and instruction are far more pervasive than was ever imagined. PLATO systems abound across the world in a variety of forms. High-end computer workstations are announced solely for the higher education marketplace. The CERL PLATO system has delivered nearly 20,000,000 hours of instruction on 100+ systems. NSF and NIE grants for CBE are too numerous to mention. CBT is taken for granted in most high technology industry. Textbooks abound. Good quality courseware at reasonable cost is as close as Kinko's copy centers. ADCIS is experiencing continued strong growth after thirty years.

I have taken a break from day-to-day involvement in CBL, choosing instead to concentrate on updating "credentials" in software engineering and expert systems in both academia and the space industry (Modesitt, 1986, 1987b, 1987c, 1988a, 1988b, 1989a, 1989b). Significant work on the California State PLATO system at was squeezed out by too-long days in hectic southern California.

The time has, however, come to return to CBL. The field has matured to the point where it is no longer the "new kid on the block" fighting for respectibility. Enthusiasm is very much present, but this time it is tempered with a good dose of reality. Creative people continue to come into the field, and the good ones already present continue to devote their energies. Consequently, as a new department head of computer science, I am far better prepared to help my university participate in this evolution of computers in learning. Faculty who apply for and receive grants to develop new skills in CBL are more likely to meet with long-term success. The equipment is better and more affordable, with network access dramatically improved. The courseware base continues to grow in quantity and quality. Development methodologies and tools are more refined. Selection criteria for the "best" subject areas are in use. There are more qualified people. CBL has matured to become a commercial success.

## LOOKING TOWARD THE 1990'S: COMING OF AGE FOR CBL

I find it <u>very</u> difficult to submit this paper for a particular SIG in ADCIS. As is obvious from the preceding, my CBL experience encompasses far more than just PLATO. Moreover, the future is

definitely broader than just PLATO. As a person with both academic and industrial experience in the computer field for 25+ years, I find it impossible to ignore how CBL is already being influenced daily by efforts in computer science, software engineering and expert systems. In addition to working with people such as university professors and human resource developers, more ADCIS members should begin to interact extensively with developers of large software systems. The methodologies have an enormous overlap! ADCIS can contribute immense amounts of practical experience about human interfaces, something sorely needed in the computer science area. There is now an artificial schism between CBL, as helping people learn how to do something, and expert systems, as helping people do something directly. I am certain that efforts are being expended in these respects, however, their visibility is zero, for all practical purposes. As a software and knowledge engineer who is also a professor, and hence has a very large repertoire of professional reading, I am amazed at how little CBL has pervaded my other fields of interest.

I challenge ADCIS to make its significant presence known outside the field of CBL. I am firmly convinced that the results will make former successes pale in comparison.

## BIBLIOGRAPHY

Asgari, D. & Modesitt, K. (1986). Space Shuttle Main Engine Test Analysis -- A Case Study for Inductive Knowledge-based Systems Involving Very Large Data Bases. IEEE Computer Society International Conference on Computers and Application Conference (COMPSAC), Chicago, October, pp. 65-71. Also appeared in Rockwell International Software Engineering Symposium Proceedings, Cedar Rapids, 1986, pp. 10.2.1-10.2.9. Also presented to Concurrent Computer Corporation, McDonnell Douglas, Rolls-Royce, and Ruston Gas Turbines, Ltd., 1987.

Daumann, A. & Modesitt, K. (1985). Space Shuttle Main Engine Test Analysis Using Knowledge-based System. International Conference on Computers in Mechanical Engineering (ASME), August, pp. 55-62. Also presented at the Turing Institute in Glasgow, Scotland, 1985.

Modesitt, K. (1974a). PSI: A Valuable Addition to the Alphabet Soup for Computer Science Education. ACM Special Interest Group on Computer Science Education (SIGCSE) Bulletin.

Modesitt, K. (1974b). An Excellent Mixture for PSI: Computer Science, PLATO, and Knowledge Levels. National Conference on Personalized Instruction; ACM National Conference, 1974, pp. 89-92.

Modesitt, K. (1975). Personalized Systems of Instruction in Computer Science: "Adult" Education. National Conference on Personalized Instruction in Higher Education.

Modesitt, K. (1976). The Tangled Triangle: Cooperation, Computer Science Education, and Personalized Systems of Instruction. ADCIS National Conference; National Conference on Personalized Instruction, 1976; Computers and Society Bulletin of ACM Special Interest Group on Computers and Society, Summer, 1977.

Modesitt, K. (1977a). Cooperation in Computer Science: Building a Community of Adults. AEDS National Conference; ACM Computer Science Conference, 1977.

Modesitt, K. (1977b). A Community of Individuals: Cooperation and Individualization in Computer Science Education. National Computer Conference, pp. 561-567; National Conference on Personalized Instruction, 1977; ADCIS National Conference, 1977; Indiana University Computer Network Conference, 1977; Computers and Education, An International Journal, 1978, pp. 227-234.

Modesitt, K. (1979). An Academic Meets Industry: Rethinking Computer-Based Education and Personalized Systems of Instruction. National Computer Conference, pp. 403-405; National Conference for Personalized Instruction, 1979.

Modesitt, K. (1981a). Retreat, Endure, or Advance: The Impact of the Third Wave on Training and Education. NSPI Performance and Instruction Journal, December, pp. 5-14.

Modesitt, K. (1981b). Training and Education at Texas Instruments: Coming of Age in Corporate Life, ADCIS National Conference, ASEE National Conference, 1981, pp. 938-943.

Modesitt, K. (1982). Computer Based Training: A Good Solution in Search of a Problem. ADCIS and NSPI National Conferences. Revised version at American Society of Training and Development (ASTD) National Conference, 1982.

Modesitt, K. (1983). Computer Based Learning: Important Problems, Creative People, and Powerful Affordable Tools. Journal of Computer-Based Instruction, Vol. 9, May, pp. 26-33. IEEE International Conference on Consumer Electronics, June, 1983, pp. 206-207. Also Association of Educational Data Systems (AEDS) National Conference, 1983, pp. 213-217; National Society for Performance and Instruction (NSPI) National Conference, 1983.

Modesitt, K. (1986). Expert Systems in the United States: Choosing an Expert System Development Tool. Invited talks for the Expert System Workshop, Mitsui Corporation, Tokyo and Osaka, Japan, 1986. Also given at the DARPA-sponsored workshop on Expert System Tools, RAND Corporation, Santa Monica, 1986.

Modesitt, K. (1987a). The Four Ws of Expert Knowledge-Based Systems: Why, What, When and Why Not. National Computer Graphics Association Conference, Philadelphia, pp. 25-32.

Modesitt, K. (1987b). Experts: Human and Otherwise. Third International Expert Systems Conference, London, England, pp. 333-342; also presented at California State University Colloquium and Citicorp, 1988.

Modesitt, K. (1987c). Space Shuttle Main Engine Anomaly Data and Inductive Knowledge Based Systems: Automated Corporate Expertise. Third Conference on Artificial Intelligence for Space Applications, NASA, Huntsville. Also presented at the International Symposium on Expert Systems in Practice, Ronneby, Sweden, 1987 and the Rockwell Software Engineering Symposium, Anaheim, 1988.

Modesitt, K. (1988a). Experience with Commercial Tools Involving Induction on Large Databases for Space Shuttle Main Engine Testing. Invited talk for Fourth International Expert Systems Conference (pp. 219-230), London, England.

Modesitt, K. (1988b). Expert Systems Tutorial: Basic Concepts. Western Conference on Expert Systems, IEEE, Anaheim, CA, June.

Modesitt, K. (1989a). Computer Learning in Engineering: Different Perspectives. Society for Machine Intelligence. Detroit, MI.

Modesitt, K. (1989b). Inductive Learning in Engineering. Tutorial for the International Special Interest Group on Inductive Programming, Detroit, MI.

Warman, D. & Modesitt, K. (1988). A Student's View: Learning in an Introductory Expert System Course. Expert Systems: International Journal of Knowledge Engineering (pp. 30-39).

Warman, D. & Modesitt, K. (1989). Learning in an Introductory Expert System Course. IEEE Expert, Spring (pp. 45-49).

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